REMARKS

In the Office Action mailed July 10, 2006, claims 11 and 16 are currently pending. Claims 11 and 16 are rejected under 35 U.S.C. 103(a) as being allegedly unpatentable over Faruqi et al. (WO 97/02563) in view of Chen (U.S. Patent No. 5,257,133) and Tanaka (U.S. Patent No. 5,684,641).

Applicants respectively traverse. After a careful review of the Office Action, the cited references, and Applicants' proposed claim clarifications, Applicants respectively request reconsideration in view of the following remarks.

I. CLAIM REJECTIONS UNDER 35 U.S.C. § 103(a)

Claims 11 and 16 stand rejected under 35 U.S.C. § 103 (a) as being allegedly unpatentable over Faruqi et al. (WO 97/02563) in view of Chen (U.S. Patent No. 5,257,133) and Tanaka (U.S. Patent No. 5,684,641). Applicants respectively traverse.

A. Applicants' Presently Claimed Invention Is Directed to Polarization Holography

Polarization holography is a method that utilizes two waves having different linear polarization. During a holographic recording these can be reconstructed with the same direction of polarization and can therefore interfere. Unlike any of the cited art, Applicants' presently claimed invention is directed to solving such interference.

Unlike any of the references cited by the currently pending Final Office Action, and as mentioned in Applicants' Specification, the document "Side-chain liquid crystalline polyesters for optical information storage," published in OPTICS LETTERS, vol. 17 No. 17, September 1992, pages 1234-1236, New York, US mentions the possibility of polarization holographic recording in combination with different write and read laser wavelength. However, this document does not address the problem of distortion caused by the difference in the

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wavelengths. Applicants' Specification Page 3 Lines 12-17. As discussed in greater detail below, none of the cited references teach or suggest the use of polarization holography~~ie~~, much less teach or suggest how such distortion is to be remedied.

More specifically, Applicants' presently claimed invention generally relates to a holographic recording process utilizing polarisation holography. For example, and as Applicants explain, the holographic recording process utilised in the invention is the so-called polarisation holography. Polarisation holographic recording is accomplished by two plane waves having mutually orthogonal polarisation. In this type of recording the resulting light field is not modulated by intensity but only by polarisation. The induced optical anisotropy (dichroism or birefringence) is spatially modulated in accordance with the polarisation modulation of the recording light field, i.e., a polarisation holographic grating is recorded.

The various possibilities for recording polarisation holographic gratings are known. It has also been shown that the diffraction efficiency (η) depends on the type of polarisation interference pattern, which forms the basis of the polarisation multiplexing. This is based on the fact that at sufficiently large values of photo-induced anisotropy it is feasible to record polarisation gratings with high efficiency, up to 25% for amplitude modulation and up to 100% for phase modulation. When the recording is accomplished with two orthogonal circularly polarised waves, η is strongly dependent on the ellipticity of the reconstructing wave. By varying the ellipticity, η can vary from 0 to its maximum value. If the object and reference waves have parallel polarisations an ordinary intensity interference pattern results, i.e., the light field intensity is sinusoidally modulated. When the two waves have mutually orthogonal polarisations (as now expressly recited in Applicants' claims), the intensity of the resultant light field is constant and only its polarisation is periodically spatially modulated in accordance with

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the change of the phase shift between them producing a polarisation interference pattern. Both interference effects may be recorded with suitable materials. In the embodiments of the apparatus shown in Figs. 2 and 3 of Applicants' Specification, it is contemplated to utilise both effects. In the preferred version the object SLM 25 provides intensity modulation, but the reference beam 16 and the object beam 15 are also orthogonally polarised, to improve the readout SNR. Applicants' Specification Page 15 Lines 1 – 26.

Applicants' presently pending independent claims are directed to such a recording process. For example, sole Independent Claim 11 and sole dependent claim 16 have now been amended to further clarify that the pending claims are directed to polarization holography. For example, sole Independent Claim 11 now expressly recites "Apparatus for the writing and reading of a holographic recording medium, preferably an optical card (2), *in the form of two-dimensional bit maps*." (emphasis added). In addition, Independent Claim 11 now expressly recites:

> the wavelength of the reading light source (21) is different from the writing light source (20), recording data in a multiple recording layer, of the thickness of 250 -1000 nm; the writing source (20) is of the kind of polarization holography;

(emphasis added).

And dependent claim 16 now expressly recites the further limitation that the Apparatus of claim 11 includes "the read optics and the write optics have a common objective lens (47) for imaging the reference and object beams (18, 16) overlapping each other to make a hologram having orthogonal polarizations." (emphasis added).

B. None Of The Cited References Teach or Suggest Polarization Holography And Therefore Do Not Teach or Suggest Applicants' Presently Claimed Invention

None of the cited references teach or suggest **polarization holography** and therefore do not teach or suggest Applicants presently claimed invention. For example, Faruqi '563 does not

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teach or suggest Applicants' presently claimed invention. As an initial matter, Applicants have identified certain differences and limitations of the optical storage system taught and suggested by Faruqi '563 and these were long ago noted in Applicants' originally filed patent application. As just one example, at page 3 line 18 – page 4 line 2 Applicants explained:

> The document WO-A-97/02563 ["Faruqi '563"] discloses an optical system for holographic recording. This known system also includes lasers with a different read and write wavelength. The suggested data storage medium is a card with a thick (50nm) holographic storage layer. Different forms of holography are suggested, **but polarisation holography is not mentioned**. The write and read optics contain waveguide structures in combination with detector cells to read out the data, instead of traditional optical systems. The optical head detects the intensity modulation caused by the recorded holograms directly, and there is no imaging system between the storage medium and the optical head. Therefore, the problem of wavelength distortion is not addressed either. On the other hand, the disclosed complex waveguide head comprises expensive acousto-optical elements and other electro-optical devices which require very sophisticated control and power supply systems. This optical head can not be manufactured in a cost-effective way with current technology.

(emphasis added)

Therefore, one fundamental distinction between Applicants' presently claimed invention and Faruqi '563 relates to the type of recording used. For example, Applicants' have now further clarified Claim 11 so that it is expressly recites that the writing light source uses "polarization holography." Claim 11 expressly recites an optical card "in the form of two-dimensional bit-maps" and that the "writing source (20) is of the kind of polarization holography."

Polarization holography is fundamentally different from the type of recording taught and suggested in Faruqi '563, i.e., polarization multiplexing. In polarization holography, the two beams overlapping to make a hologram have orthogonal polarizations, such as orthogonal circular polarization. For polarization holography, therefore, the storage medium has to be polarization sensitive. This is different from Faruqi '563 which expressly teaches that:

> The usual holographic recording process involves the interference of two coherent, parallel polarisation light beams on an appropriate photosensitive

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> material (photopolymerisable/photocrosslinkable) . . . The variation in intensity in the resulting interference pattern causes the complex index of refraction to be modulated throughout the volume of the medium.

Faruqi '563 at page 3 line 31 – page 4 line 5.

In Applicants' presently claimed invention, the materials are neither photopolymerisable nor photocrosslinkable. In Applicants' presently claimed invention, the intensity does not vary and the index of refraction is modulated through a reorientation of the molecules on irradiation with polarized light.

In addition, even though the laser is inherently a polarized source, the method taught in Faruqi '563 utilizes interference of two coherent, parallel polarizations. In contrast, Applicants' presently claimed invention utilizes two beams that have orthogonal polarization and the polarization of the object beam is not modulated. Rather, the object beam passes through a two dimensional bit-map and gets intensity modulated. To further clarify Applicants' presently claimed invention, Claim 11 has now been amended to recite that the holographic recording medium is a "two-dimensional bit-maps."

Another important difference between Applicants' presently claimed invention and Faruqi '563 lies in the thickness of the recording medium used. For example, Applicants' presently pending sole Independent Claim 11 now expressly recites "recording data in a multiple layer of the thickness of 250-1000 nm." For example, Applicants explain that according to one aspect of the invention, for the method it is suggested to use a holographic recording medium, such as a memory card having a carrier substrate, a holographic recording layer sensitive to light, and a reflection layer between the carrier substrate and the recording layer. In the recording medium of the invention the recording layer is a polarisation sensitive polymer material, and the thickness of the recording layer is 0.5-2 times the wavelength of the reading and/or recording

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light. As the wavelength for recording is 500 nm, the thickness of the film according to the above will be 250-1000 nm. Applicants' Specification at page 5 lines 13 – 18.

Such a thin recoding medium is not described in Faruqi '563. As Faruqi '563 explains, the Faruqi '563 optical storage system concerns the use of a recording medium with a thickness of typically 50 μm. According to Faruqi '563, "The storage medium is typically 50 μm thick and able to store multiple diffraction patterns at varying depths." Faruqi '563 page 16, lines 25-26.

Yet another important distinction between Applicants' presently claimed invention and Faruqi '563 lies in the part of the invention, which relates to the recording methods used. For example, currently pending Independent Claim 11 expressly recites that the recording medium is in the form of "two-dimensional bit-maps."

In contrast, Faruqi '563 does not record using "two-dimensional bit-maps." Rather, Faruqi '563 appears to record single bits as holograms. In contrast, the objects in Applicants' presently claimed invention are two-dimensional bit-maps such as may be presented on a Liquid Crystalline Spatial Light Modulator (LCSLM).

Another difference between Applicants' presently claimed invention and Faruqi '563 is that in Applicants' presently claimed invention the data storage capacity of the optical storage card can be increased by recording data in multiple layers. Again, Applicants' have clarified this aspect with presently pending claim 11: "recording data in a multiple recording layer of the thickness of 250-1000nm." In contrast, and as described above, Faruqi '563 teaches recording data in only a single layer. Applicants' Specification at page 3, lines 23-36.

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II. SUMMARY

Applicants respectfully submit that, in view of the remarks above, the present application, including claims 11 and 16, are in condition for allowance and solicit action to that end.

If there are any matters that may be resolved or clarified through a telephone interview, the Examiner is respectfully requested to contact Applicants' undersigned representative at (312) 913-0001.

Respectfully submitted,

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Date: May 14, 2007

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